GATES LEARJET CORPORATION

maintenance manual

CHAPTER

77

ENGINE INDICATING

Chapter Section Subject	Page	Date
77-Title		
*77-List of Effective Pages	1	Dec 10/82
*77-Contents	1	Dec 10/82
77-00-00	1	Dec 2/77
77-10-00	1	Dec 2/77
77-10-00	2	Dec 2/77
*77-11-00	201	Dec 10/82
*77-11-00	202	Deleted
77-12-00	201	Dec 2/77
*77-12-00	202	Dec 10/82
*77-12-00	203	Dec 10/82
77-20-00	1	Dec 2/77
77-20-01	201	Dec 2/77
77-20-01	202	Dec 2/77
*77-31-00	1	Dec 10/82
*77-31-00	2	Dec 10/82
*77-31-00	201	Dec 10/82
*77-31-00	202	Deleted
*77-31-00	203	Deleted
*77-31-00	204	Deleted
*77-31-01	201	Dec 10/82
*77-31-01	202	Dec 10/82
*77-31-01	203	Dec 10/82
*77-31-02	201	Dec 10/82
*77-31-02	202	Dec 10/82
*77-31-02	203	Dec 10/82

Chapter Section Subject	Page	Date

Insert Latest Revised Pages; Destroy Superseded or Deleted Pages.
*Asterisk indicates pages revised, added or deleted by current revision.
The portion of the text affected by the current revision is indicated by a vertical line in the outer margin of the page.

Subject	Chapter Section Subject	Page
GENERAL	77-00-00	
General	77-00-00	1
POWER	77-10-00	
General	77-10-00	1
Operation	77-10-00	1
Engine Tachometer System - Maintenance Practices	77-11-00	
Removal/Installation	77-11-00	201
Engine Pressure Ratio System - Maintenance Practices	77-12-00	
General	77-12-00	201
Removal/Installation	77-12-00	201
TEMPERATURE	77-20-00	
General	77-20-00	1
Operation	77-20-00	1
Thermocouple Spool Assembly - Maintenance Practices	77-20-01	
General	77-20-01	201
Removal/Installation	77-20-01	201
Adjustment/Test	77-20-01	
ENGINE STALL WARNING SYSTEM - DESCRIPTION AND OPERATION	77-31-00	
Description	77-31-00	1
Operation	77-31-00	1
Engine Stall Warning System - Maintenance Practices	77-31-00	
Inspection/Check	77-31-00	201
Engine Stall Warning Box Assembly	77-31-01	
Removal/Installation	77-31-01	201
Adjustment/Test	77-31-01	201

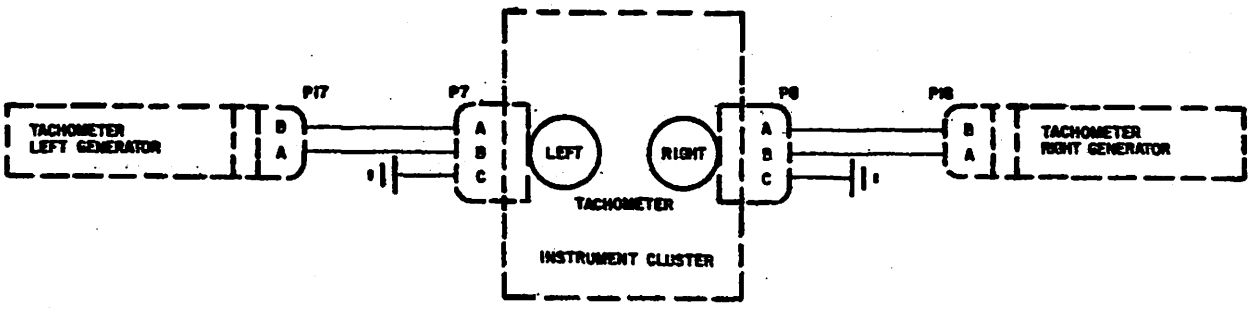
GENERAL - DESCRIPTION AND OPERATION

1. General
 A. Each engine is equipped with individual Exhaust Gas temperature (EGT), Engine Pressure Ratio (EPR) and an engine tach (% rpm) systems.
 B. The indicating systems provide the crew members with visual indications of engine operation at all times.
 C. An engine synchronizer system is installed as optional equipment.

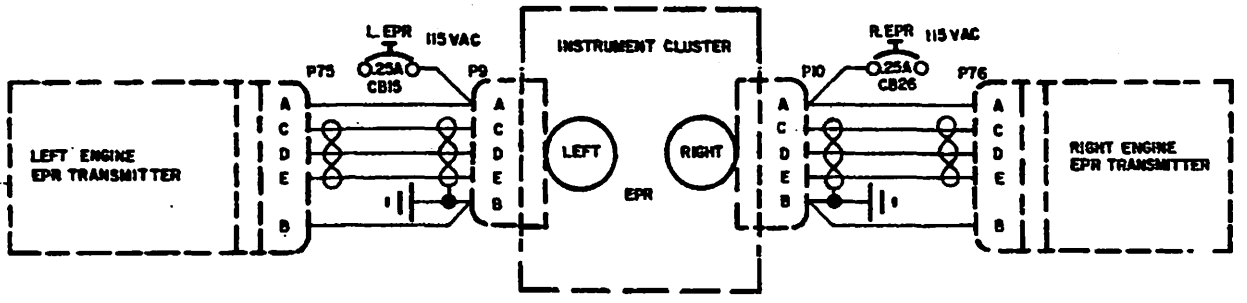
POWER - DESCRIPTION AND OPERATION

1. General
 A. The engine tachometer system consists of a tachometer generator, mounted on the rear of each engine-driven lube pump housing, and the tachometer indicators on the instrument panel.
 B. The pressure ratio indicating system provides engine pressure ratio readings to the pilot. The system for each engine consists of engine exhaust inlet probes in the engine tailcone, a transducer in the aft fuselage, an EPR indicator on the instrument panel, and the pitot air pressure source.

2. Operation
 A. Engine rotation operates the three-phase AC tachometer generator which generates power to operate the tachometer indicators. Each indicator is a synchronous motor operating a magnetic drag element coupled by two pointers. The pointers indicate the synchronous motor speed and therefore the engine rpm. Dial markings are based on percent of maximum allowable engine speed. The large dial is graduated in 2% increments from 0% to 100%; the small dial is graduated in 1% increments from 0% to 10%. Using the small dial for the last 10%, the maximum indicator reading is 110%. No adjustment should be attempted. In case of malfunction, replace defective component.
 B. The transducer senses engine exhaust pressure (PT_5) and pitot inlet air pressure (PT_2). The ratio of these two pressures is amplified within the transducer with the resultant electrical signal being applied to the EPR indicator. System power is 115 vac, 400 cycles, supplied through a circuit breaker. No system adjustment should be attempted. In case of malfunction, replace defective component.



Engine Tachometer Schematic



Engine EPR Schematic

Engine Tachometer & EPR Systems Electrical Control Schematic
Figure 1

ENGINE TACHOMETER SYSTEM - MAINTENANCE PRACTICES

1. Removal/Installation

A. Remove Tach Generator (See figure 201.)

(1) Remove engine lower nacelle.

(2) Disconnect electrical connector from tachometer generator.

(3) Remove attaching nuts and tachometer generator from aircraft.

B. Install Tach Generator (See figure 201.)

(1) Apply a coat of Mobil Grease No. 29 or Braycote 664S to shaft of tachometer generator. Before installing tachometer generator, clean fitting cavity in rear of lube pump housing.

(2) Install tachometer generator and secure with nuts. Torque nuts 25 to 35 inch-pounds.

(3) Connect electrical connector to tachometer generator.

(4) Install engine lower nacelle.

C. Remove Indicator

(1) Remove avionics control heads as necessary to gain access to engine tachometer indicator.

(2) Disconnect electrical connector from indicator.

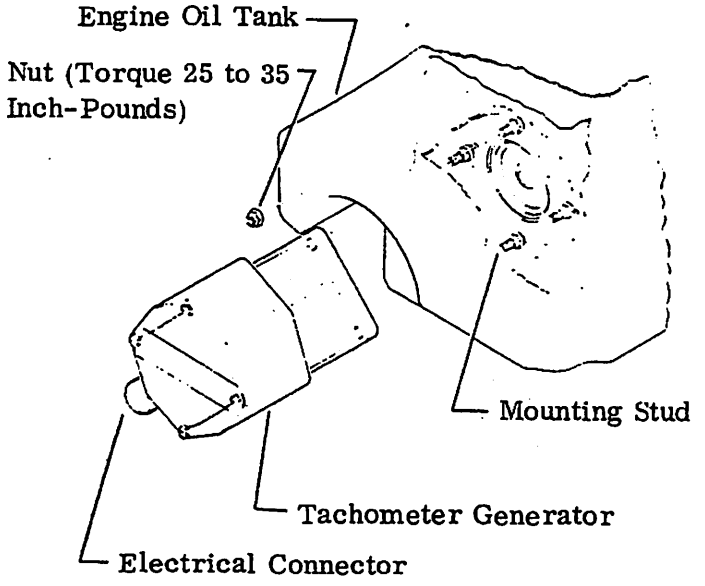
(3) Lossen clamp and remove instrument from panel.

D. Install Indicator

(1) Install indicator in panel and secure with clamp and attaching parts.

(2) Connect electrical connector to indicator.

(3) Install avionics control heads.

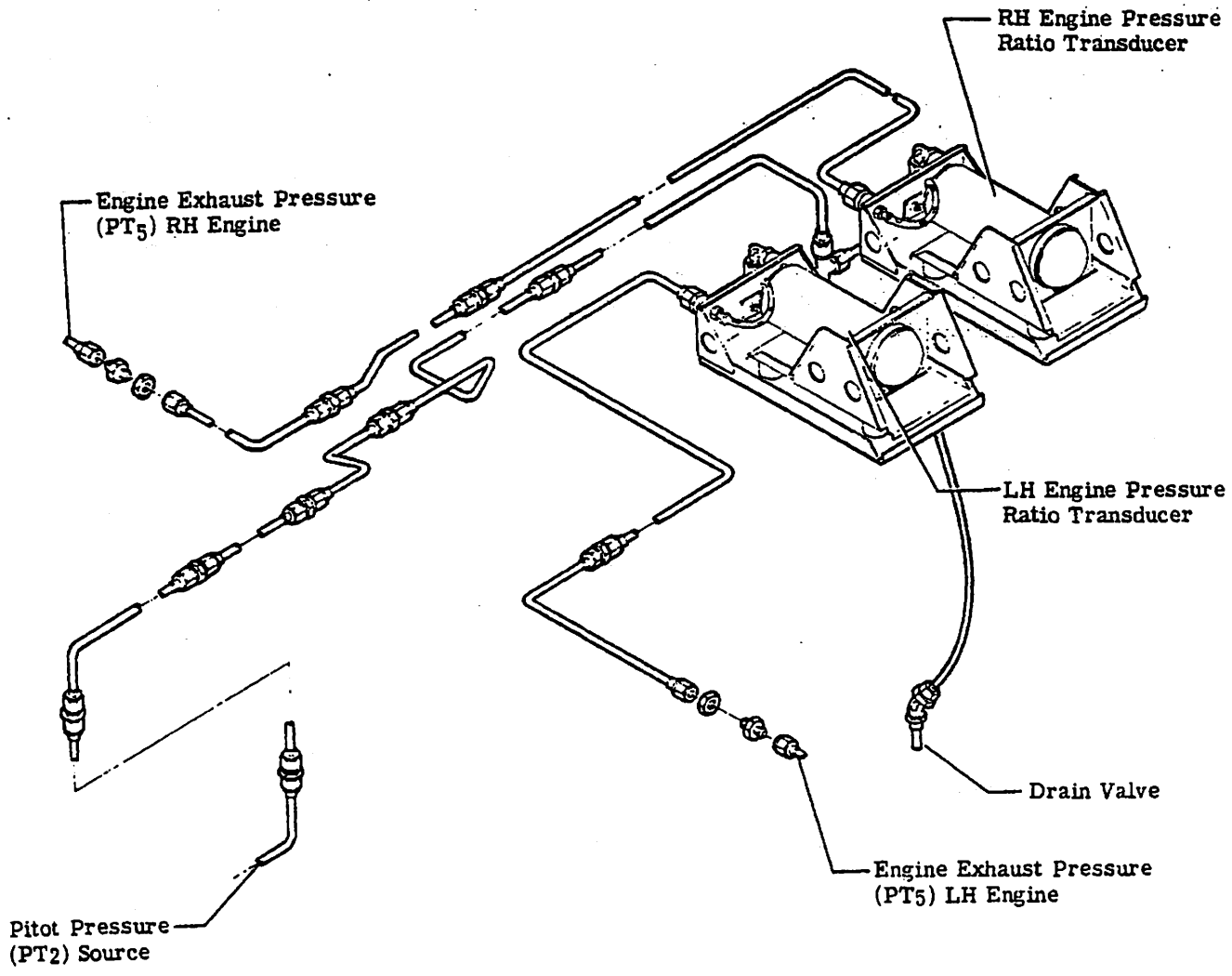


Engine Tachometer System Installation
Figure 201

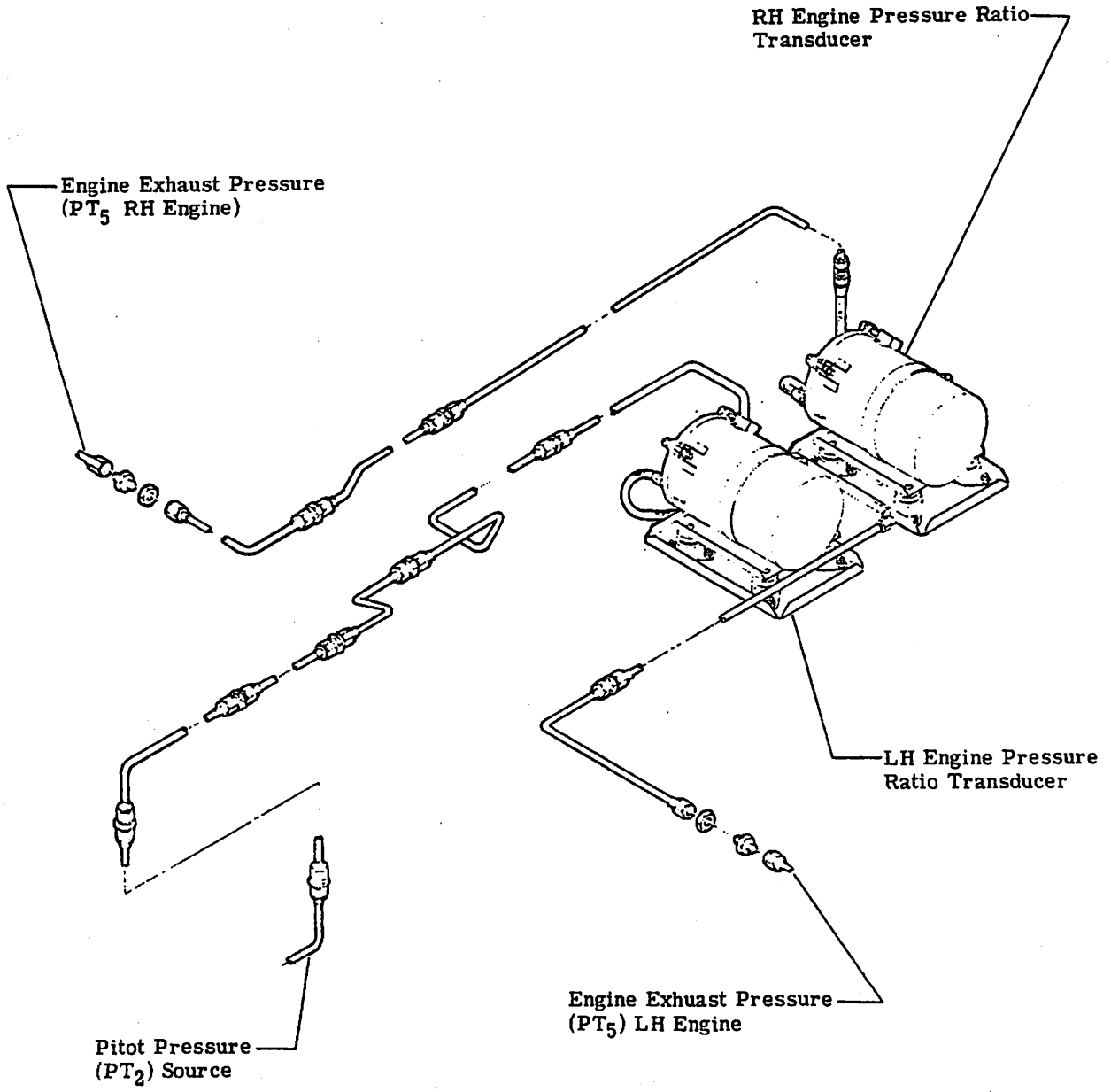
ENGINE PRESSURE RATIO SYSTEM - MAINTENANCE PRACTICES

1. General
 A. Maintenance practices consists of electrical checks and replacement of defective components.

2. Removal/Installation
 A. Remove Pressure Ratio Transducer (See figure 201)
 (1) Lower Tailcone access doors and disconnect aircraft batteries.
 (2) Disconnect and cap plumbing from transducer.
 (3) Disconnect electrical plug from transducer.
 (4) Remove attaching parts and transducer from aircraft.
 B. Install Pressure Ratio Transducer (See figure 201)
 (1) Install transducer and secure with attaching parts.
 (2) Connect electrical plug to transducer.
 (3) Remove caps from plumbing and connect plumbing to transducer.
 (4) Connect aircraft batteries and secure tailcone access door.
 C. Remove Indicator
 (1) Remove avionics control heads as necessary to gain access to engine pressure ratio indicator.
 (2) Disconnect electrical plug from indicator.
 (3) Loosen and remove attaching parts and indicator from panel.
 D. Install Indicator
 (1) Install indicator and secure with attaching parts.
 (2) Connect electrical plug to indicator.
 (3) Install avionics control heads.



Engine Pressure Ratio System Components Installation
Figure 201 (Sheet 1 of 2)



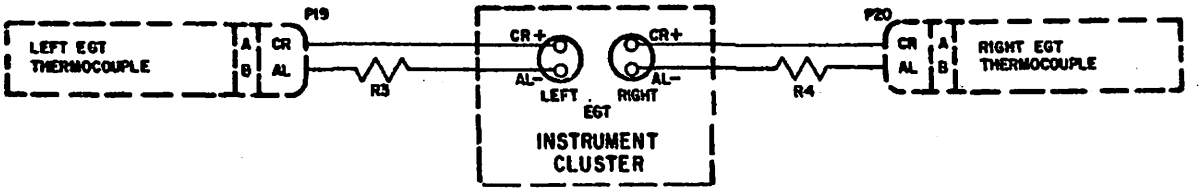
Engine Pressure Ratio System Components Installation
Figure 201 (Sheet 2 of 2)

EFFECTIVITY: 25-143 AND SUBSEQUENT when equipped with Honeywell EPR Transducer

TEMPERATURE - DESCRIPTION AND OPERATION

1. General
 A. An identical exhaust gas temperature indicating system is installed for each engine. Each system consists of an exhaust gas temperature indicator, a thermocouple spool resistor, and eight harness-mounted bayonet-type chromel-alumel thermocouples. The thermocouples are mounted at two different immersion depths in the engine tailpipe. The resistors are located in the tailcone area.

2. Operation
 A. The thermocouples, heated by the exhaust gases, generate a small amount of voltage which is applied to the indicator by the chromel and alumel leads. The compensating resistor is located in the alumel side of each circuit. The indicators are sensitive millivoltmeters with dials graduated in degrees Centigrade from 0° to 1000° C. They provide the pilot with visual indications of the existing average temperature within each tailpipe.

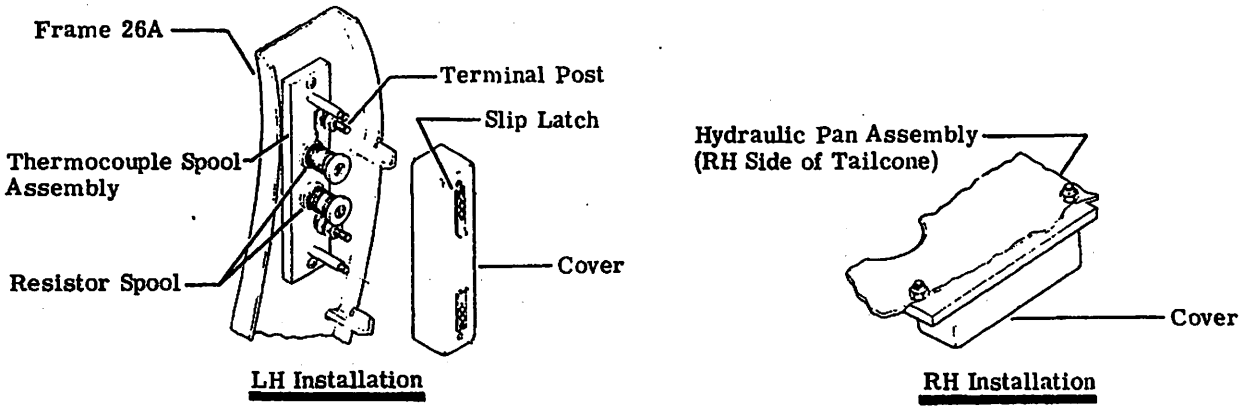


Engine Exhaust Gas Temperature Electrical Control Schematic
Figure 1

THERMOCOUPLE SPOOL - MAINTENANCE PRACTICES

1. General
 A. The thermocouple spool assembly contains two spools of constantan wire (one is a spare); the other is adjusted to bring the exhaust gas temperature system circuit resistance to a value of 8.00 (±0.05) ohms. All wire connections to the thermocouple resistor spool are silver soldered.
 B. For maintenance on the thermocouple harness, refer to engine maintenance manual.

2. Removal/Installation
 A. Remove Thermocouple Spool Assembly (See figure 201)
 (1) Lower tailcone access door and disconnect aircraft batteries.
 (2) Remove cover from thermocouple spool assembly.
 (3) Disconnect electrical wiring from terminal posts.
 (4) Remove attaching parts and remove assembly.
 B. Install Thermocouple Spool Assembly (See figure 201)
 (1) Install thermocouple spool assembly and secure with attaching parts.
 (2) Connect electrical wiring to terminal posts.
 (3) Install cover and secure with slip latches.
 (4) Test the exhaust gas temperature circuit resistance.



Thermocouple Spool Installation
Figure 201

3. Adjustment/Test

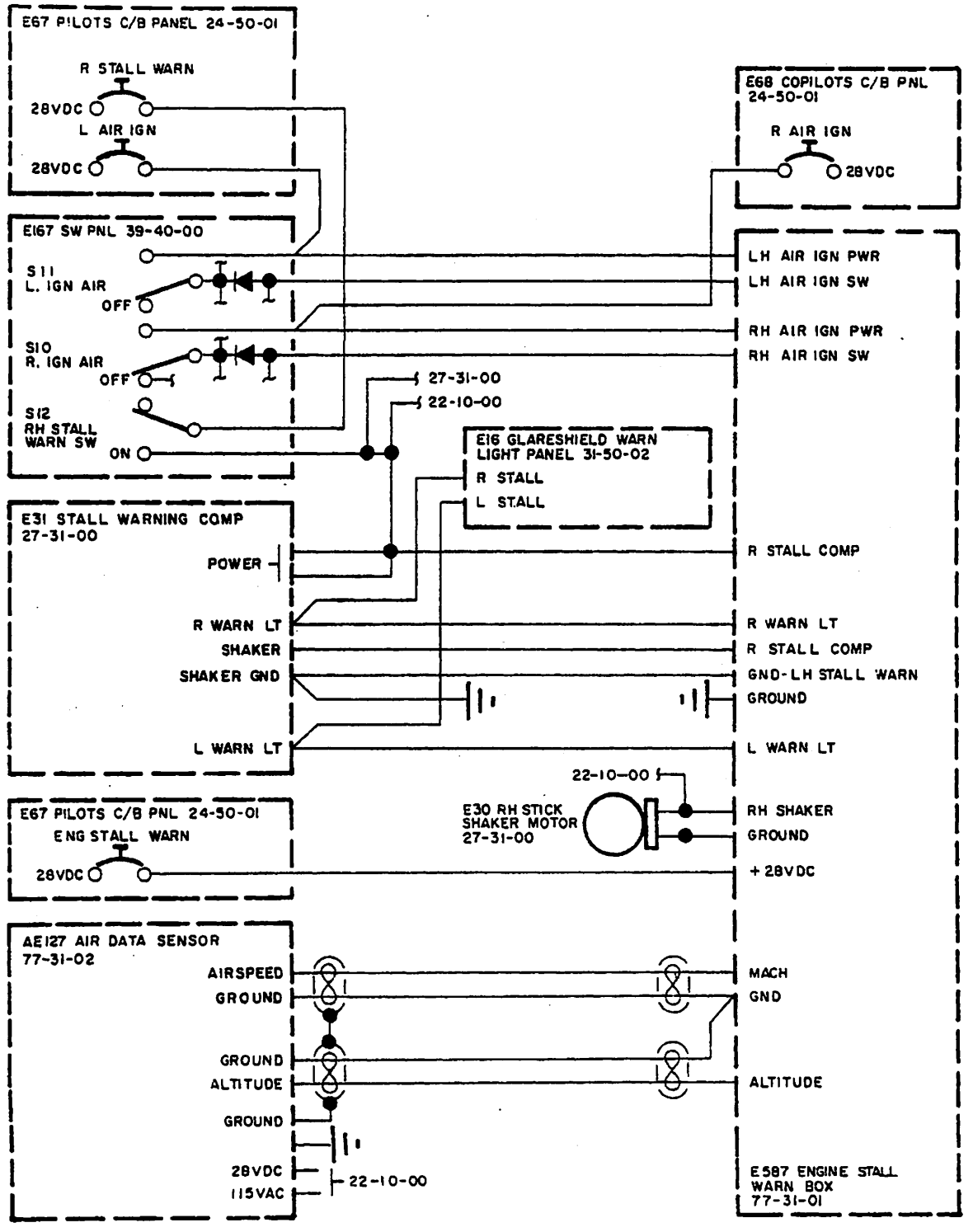
A. Resistance Test of Thermocouple Couple Spool

(1) When any element in the exhaust gas temperature indicating circuit is changed, or if an engine is replaced, the exhaust gas temperature circuit resistance must be tested and, if necessary, adjusted. It is recommended that a Jetcal Analyzer be used for testing. For required engine temperature versus engine rpm, refer to Engine Operations Manual SEI-188.

ENGINE STALL WARNING SYSTEM - DESCRIPTION AND OPERATION

1. Description (See figure 1.)
 A. The engine stall warning system consists of an engine stall warning box assembly located in the nose wheel well.
 B. The engine stall warning box assembly consists of three (monitor, power, and logic) printed circuit boards.
 C. The engine stall warning box assembly is connected electrically to the stall warning computer, air data sensor, RH stick shaker, left and right AIR IGN switches, and the ENG STALL WARN circuit breaker on the pilot's circuit breaker panel.

2. Operation (See figure 1.)
 A. The engine stall warning box assembly (power printed circuit board) receives electrical power through a 2 amp circuit breaker located on the pilot's circuit breaker panel. The power printed circuit breaker distributes electrical power to the logic and monitor printed circuit boards.
 B. The engine stall warning assembly (monitor printed circuit board) receives electrical signals from the air data sensor. These signals represent altitude and airspeed which are analyzed by the logic printed circuit board.
 C. Should the airspeed fall 0.02 Mach below the engine stall Mach limit for the altitude of the aircraft, a signal is sent to the stall warning computer and RH stick shaker. The stall warning computer and stick shaker physically and visually alert the pilot of the impending engine stall (flame-out). The R STALL and L STALL (on the glareshield warning light panel) flash, the shaker/nudger system actuates, both air ignition lights (adjacent to each AIR IGN Switch) illuminate, and power is provided to the engine ignitors.
 D. When either the airspeed is increased or the altitude is decreased, the electrical signal is withdrawn from the stall warning computer and stick shaker motor. The R STALL and L STALL warning annunciators extinguish, shaker/nudger system deactivates, both air ignition lights extinguish, and the engine ignitors deactivate.



Engine Stall Warning System Schematic
Figure 1

ENGINE STALL WARNING SYSTEM - MAINTENANCE PRACTICES

1. Inspection/Check

A. Perform Engine Stall Warning Operational Check

(1) Connect a pitot-static tester (Barfield 1811F or equivalent) to the pitot static system.

(2) Set BATTERY Switches to L and R.

CAUTION: DO NOT EXCEED 5000 FEET PER MINUTE RATE OF CLIMB. DAMAGE MAY OCCUR TO FLIGHT INSTRUMENTS IF THIS LIMITATION IS NOT STRICTLY ADHERED TO.

(3) Adjust pitot-static tester to simulate altitudes and corresponding airspeeds as indicated in figure 203.

(4) At each altitude, engage autopilot and lower speed (indicated in figure 203) by 0.02 Mach. Verify the following:

(a) Both air ignition lights (adjacent to AIR IGN Switches) illuminate.

(b) Shaker/nudger system actuates.

(c) Both L STALL and R STALL annunciators flash simultaneously at a frequence of 2 Hz.

(d) Check and confirm that the control wheel master switches interrupt nudger.

NOTE: Pull L and R AIR IGN circuit breakers after first stall warning check, and reset both circuit breakers prior to making final stall warning check. During first and final checks, verify that ignitors operate by hearing ignitors pop.

(5) Using pitot-static tester, lower altitude by 600 feet. Verify the following:

(a) Air ignition lights (adjacent to AIR IGN Switches) extinguish.

(b) Shaker/nudger deactivates.

(c) R STALL and L STALL annunciators extinguish.

(6) If the engine stall warning system does not comply with this test, adjust the engine stall warning box assembly (refer to Adjustment/Test, step 3.) and repeat steps 2.A.(3) through 2.A.(6).

CAUTION: DO NOT EXCEED 500 FEET PER MINUTE RATE OF DESCENT. DAMAGE MAY OCCUR TO FLIGHT INSTRUMENTS IF THIS LIMITATION IS NOT STRICTLY ADHERED TO.

(7) When test is completed, descend to local altitude. Remove pitot-static tester from the aircraft and restore aircraft to its original configuration.

ENGINE STALL WARNING BOX ASSEMBLY - MAINTENANCE PRACTICES

1. Removal/Installation
 - A. Remove Engine Stall Warning Box Assembly (See figure 201.)
 - (1) Gain access to the engine stall warning box assembly through the nose wheel well.
 - (2) Disconnect electrical connector from engine stall warning box assembly.
 - (3) Remove attaching parts and remove engine stall warning box assembly.
 - B. Install Engine Stall Warning Box Assembly (See figure 201.)
 - (1) Position engine stall warning box assembly and secure with attaching parts.
 - (2) Connect electrical connector to engine stall warning box assembly.
 - (3) Perform engine stall warning Inspection/Check. (Refer to step 2.)
 - C. Remove Printed Circuit Board (See figure 202.)
 - (1) Remove engine stall warning box assembly. (Refer to step 1.A.)
 - (2) Remove attaching parts and printed circuit boards (assembled to cover plate) from box assembly.
 - (3) Remove attaching parts and cover plate from printed circuit boards.
 - (4) Unplug and remove printed circuit board to be replaced.
 - D. Install Printed Circuit Board (See figure 202.)
 - (1) Carefully align printed circuit boards and plug the printed circuit boards into each other.
 - (2) Secure printed circuit boards and cover plate together with attaching parts.
 - (3) Position printed circuit boards (assembled to cover plate) in the box assembly and secure with attaching parts.
 - (4) Install engine stall warning box assembly. (Refer to step 1.B.)

2. Adjustment/Test
 - A. Adjust Engine Stall Warning Box
 - (1) Connect a pitot-static tester (Barfield 1811F or equivalent) to the pitot-static system.
 - (2) Set BATTERY Switches to L and R.
 - (3) Remove guard from engine stall warning box assembly.

 CAUTION: DO NOT EXCEED 5000 FEET PER MINUTE RATE OF CLIMB OR DESCENT. DAMAGE MAY OCCUR TO FLIGHT INSTRUMENTS IF THIS LIMITATION IS NOT STRICTLY ADHERED TO.

 - (4) Adjust pitot-static tester to simulate 46,000 feet altitude and 0.65 Mach airspeed. Using a multimeter, probe between pin 1 and pin 6 of the test receptacle. Adjust potentiometer R46 to attain a voltage reading of 9.016 (±0.005) volts.

(5) Probe between pin 1 and pin 8 of the test receptacle. Adjust potentiometer R49 to attain a voltage reading of 6.50 (±0.01) volts.

(6) Adjust pitot-static tester to simulate 40,000 feet altitude and 0.52 Mach airspeed. Using a multimeter, probe between pin 1 and pin 4 of the test receptacle. Adjust potentiometer R47 to attain a voltage reading of 7.840 (±0.005) volts.

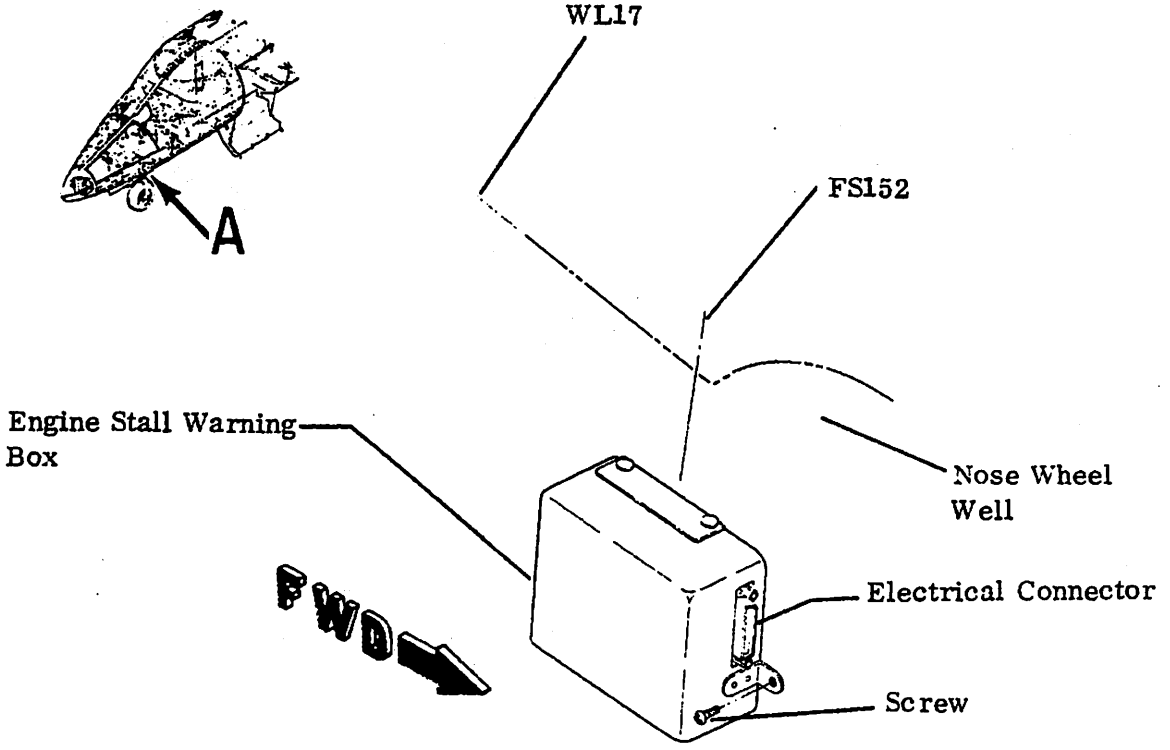
(7) Probe between pin 1 and pin 6 of the test receptacle. Adjust potentiometer R50 to attain a voltage reading of 5.20 (±0.01) volts.

(8) Adjust pitot-static tester to simulate 32,500 feet altitude and 0.38 Mach airspeed. Using a multimeter, probe between pin 1 and pin 5 of the test receptacle. Adjust potentiometer R48 to attain a voltage reading of 6.370 (±0.005) volts.

(9) Probe between pin 1 and pin 7 of the test receptacle. Adjust potentiometer R51 to attain a voltage reading of 3.80 (±0.01) volts.

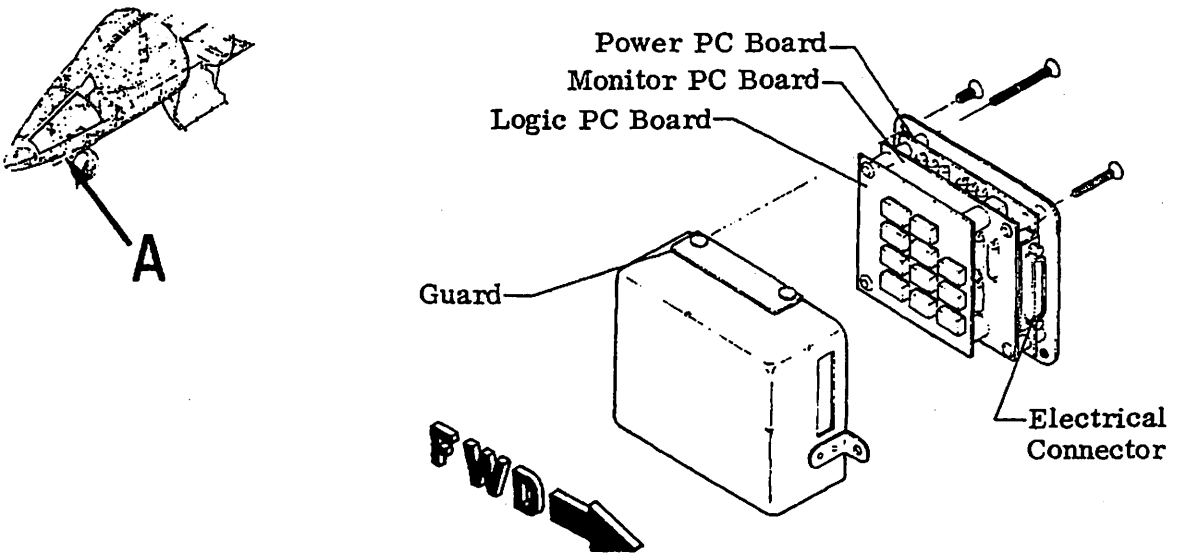
(10) Remove multimeter leads from aircraft and install guard on engine stall warning box assembly.

(11) Perform engine stall warning box operational check. (Refer to step 2.)



Detail A

Engine Stall Warning Box Assembly Installation
Figure 201



Engine Stall Warning Box Assembly Exploded View
Figure 202

CAUTION: DO NOT EXCEED 5000 FEET PER MINUTE RATE OF CLIMB OR DESCENT.

ALTITUDE FEET	AIRSPEED KNOTS
30,300 (±100)	115 (+11, -3)
33,000 (±100)	130 (+10, -4)
35,300 (±100)	129 (+11, -3)
36,300 (±100)	133 (+10, -3)
37,300 (±100)	136 (+10, -2)
38,300 (±100)	139 (+10, -4)
39,300 (±100)	142 (+10, -2)
40,300 (±100)	151 (+ 9, -3)
41,300 (±100)	154 (+ 9, -4)
42,300 (±100)	156 (+ 9, -3)
43,300 (±100)	164 (+ 8, -3)
44,300 (±100)	166 (+ 8, -3)
45,300 (±100)	174 (+ 4, -2)
46,300 (±100)	170 (± 4)

Engine Stall Warning Functional Test Altitude and Airspeed Table
Figure 203

AIR DATA SENSOR - MAINTENANCE PRACTICES

1. Removal/Installation
 - A. Remove Air Data Sensor (See figure 201.)
 - (1) Remove electrical power from aircraft.
 - (2) Remove nose compartment access doors.
 - (3) Disconnect pitot and static lines from sensor. Cap all exposed lines.
 - (4) Disconnect electrical connector from sensor.
 - (5) Remove attaching parts and sensor from aircraft.
 - B. Install Air Data Sensor (See figure 201.)
 - (1) Install air data sensor and secure with attaching parts.
 - (2) Remove caps from previously capped pitot and static sources. Connect pitot and static hose assemblies to applicable fittings on sensor.
 - (3) Connect electrical connector to sensor.
 - (4) Perform leakage check of pitot and static lines.
 - (5) Install nose compartment access doors.
 - (6) Restore electrical power to aircraft.

2. Inspection/Check
 - A. Perform Pitot Leakage Check
 - (1) Connect pitot-static tester to copilot's (RH) pitot system.

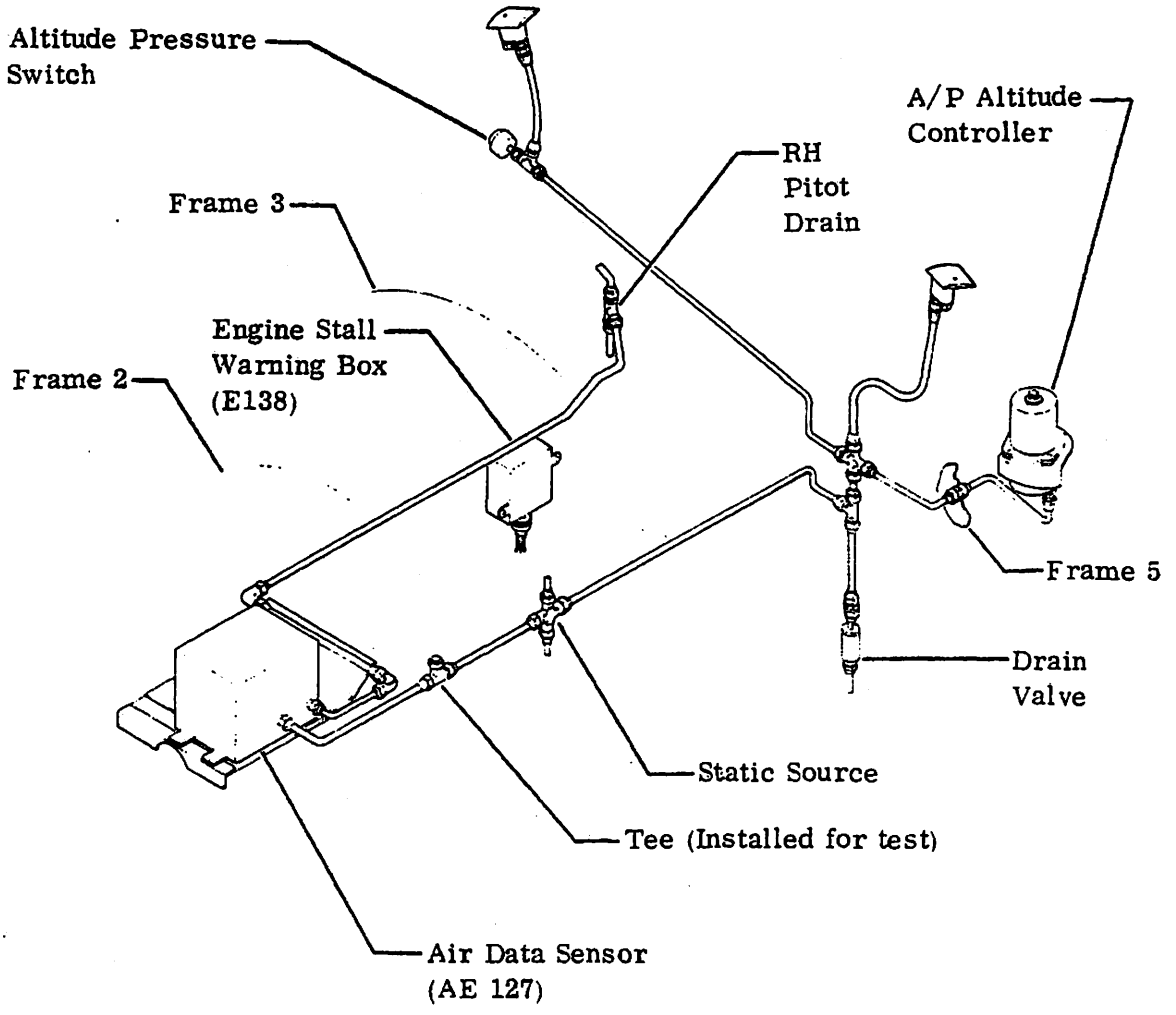
 CAUTION: APPLY ONLY PRESSURE (NOT VACUUM) TO THE PITOT SYSTEM. APPLY PRESSURE VERY SLOWLY UNTIL 80 KNOTS IS REACHED; PRESSURE APPLICATION AFTER THIS POINT MUST NOT EXCEED 20 KNOTS PER SECOND.

 NOTE: Refer to Chapter 34 for general pitot-static system maintenance practices.

 - (2) Slowly apply pressure until copilot's airspeed indicator indicates 300 knots. Rate of pressure increase shall not increase airspeed indicator in excess of 20 knots per second after 80 knots is reached.
 - (3) Turn off pressure sealing system. System pressure shall not drop in excess of 5 knots in 5 minutes.

 CAUTION: DEPRESSURIZATION RATE SHALL NOT EXCEED 20 KNOTS PER SECOND OR INSTRUMENT DAMAGE COULD RESULT.

 - (4) Slowly release pressure from copilot's pitot system and remove pitot-static tester.



Air Data Sensor System Installation
Figure 201

14-130C-1

B. Perform Static Leakage Check

CAUTION: APPLY VACUUM TO SHOULDER STATIC PORTS, COPILOT'S (RH) PITOT SYSTEM AND TO COPILOT'S STATIC SYSTEM WHEN PERFORMING AIR DATA LEAKAGE CHECK.

THE COPILOT'S PITOT SYSTEM IS COMMON TO BOTH THE AIR DATA SENSOR AND THE COPILOT"S INSTRUMENTS. THEREFORE, WITH THE APPLICATION OF VACUUM AT THE THE PITOT SOURCE, A SEVERE PRESSURE DIFFERENTIAL COULD RESULT AND DAMAGE THE INSTRUMENTS.

(1) Connect pitot-static tester to shoulder static ports, copilot's static system, and copilot's pitot system.

CAUTION: APPLY ONLY VACUUM (SUCTION) DURING THIS CHECK AND ASSURE THAT THE TEST SET CROSS-BLEED IS OPEN.

(2) Apply vacuum until copilot's altimeter indicates 28,000 feet.
(3) Turn off vacuum source, sealing system. Altimeter indication shall not decrease more than 560 feet in one minute.
(4) Slowly release vacuum and disconnect pitot-static tester from shoulder static ports and copilot's pitot and static systems.